

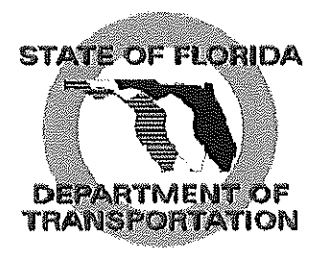
Signal Warrant Study

SR 44 at CR 42

STUDY 2
LAKE COUNTY
SECTION 11110
MILEPOST 23.703

Continuing Services for Traffic Engineering
Contract Number C-8L68
Financial Project No. 237987-1-32-12
Work Order No. 20
FDA No. 336.0202

Prepared For:



Prepared By:



Maitland, Florida
October 2007

Kevin R. Carey
10/9/07

Engineer of Record: Kevin R. Carey, P.E.
P.E. No. 61635

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1. INTRODUCTION	2
2. EXISTING CONDITIONS.....	3
Traffic Volumes.....	8
Intersection Delay	11
3. QUALITATIVE ASSESSMENT	12
4. SIGNAL WARRANT ANALYSIS	15
5. RECOMMENDATIONS.....	21

APPENDIX

FIGURES, EXHIBITS, and TABLES

FIGURES

Figure 1-Project Location Map	2
Figure 2-Condition Diagram	7
Figure 3-Collision Diagram.....	9
Figure 4-Conceptual Improvement Diagram	22

EXHIBITS

Exhibit 1-North Approach Photographs.....	4
Exhibit 2-East Approach Photographs	5
Exhibit 3-West Approach Photographs	6
Exhibit 4-Warrant 1	16
Exhibit 5-Warrant 2	17
Exhibit 6-Warrant 3	18
Exhibit 7-Warrants 4, 5, & 6	19
Exhibit 8-Warrants 7 & 8	20

TABLES

Table 1-Summary of Existing Conditions	3
Table 2-Turning Movement Count Summary	8
Table 3-Collision Summary	10
Table 4-Summary of Delay Studies	11
Table 5-Summary of Signal Warrant Analysis.....	15

EXECUTIVE SUMMARY

Faller, Davis & Associates, Inc. (FDA) conducted a Signal Warrant Study at the intersection of SR 44 and CR 42 in Lake County, Florida. Based on the results of the analysis, field observations, and engineering judgment, the following recommendations and conclusions were developed:

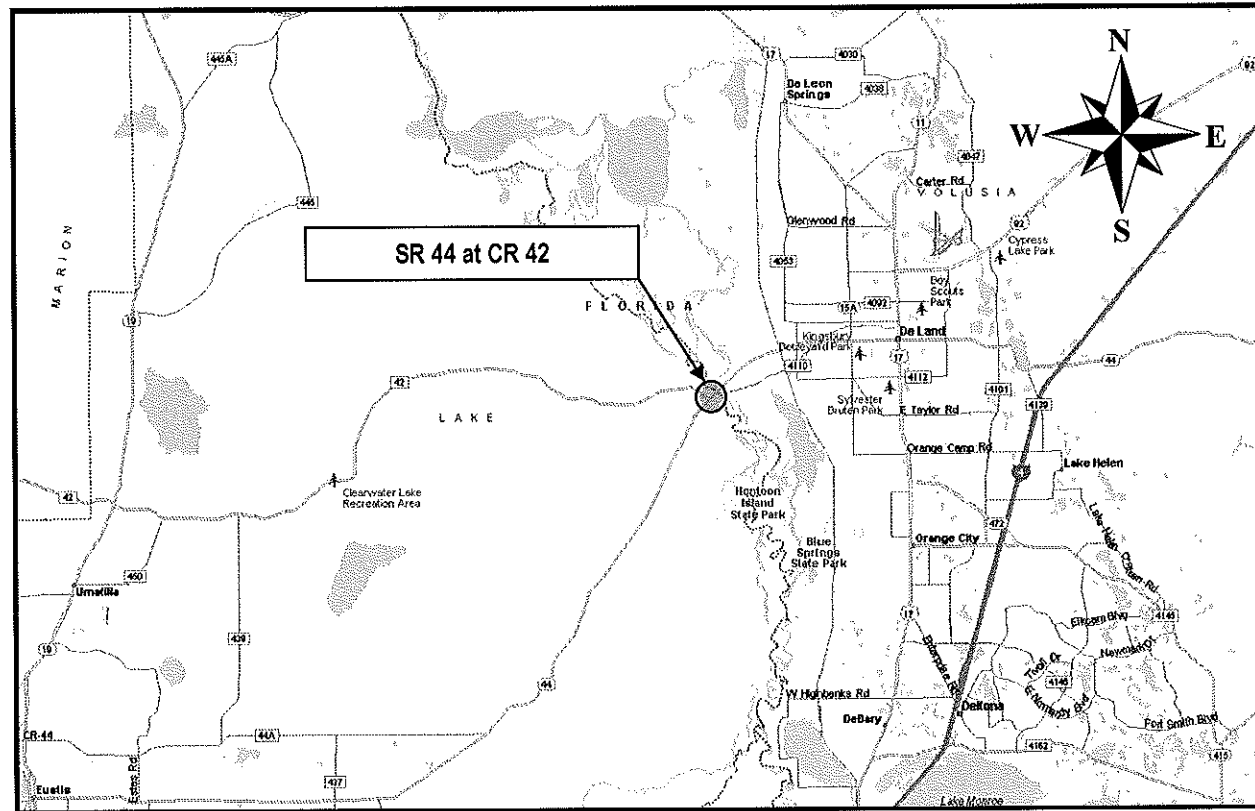
Based on warrants 1 and 2 being satisfied, a fully actuated traffic signal should be installed at this intersection. The signal should include a mainline phase and a sidestreet phase.

- A left turn phase warrant was prepared for the eastbound left turn movement and the installation of a protected eastbound left turn phase is not warranted.
- Although there is an average of 234 westbound right turns during the afternoon period of 4:00 to 6:00 PM, a protected westbound right turn overlap phase is not recommended to be installed.
- Pedestrian features are not recommended as there were no pedestrians/bicyclists observed during the count period.

1. INTRODUCTION

The Florida Department of Transportation has retained **Faller, Davis & Associates, Inc. (FDA)** to perform a Signal Warrant Study at the intersection of SR 44 and CR 42 in Lake County, Florida. The analysis methods used in conducting this study are consistent with those set forth in the Manual on Uniform Traffic Control Devices (MUTCD 2003), the Manual on Uniform Traffic Studies (MUTS), and FDOT District 5 guidelines and procedures.

Figure 1-Project Location Map



2. EXISTING CONDITIONS

The intersection of SR 44 and CR 42 is located in Lake County. Significant features for the intersection are summarized below:

Table 1-Summary of Existing Conditions

Feature	Description
Main Street	<ul style="list-style-type: none"> • SR 44
Side Street	<ul style="list-style-type: none"> • CR 42
Area Location	<ul style="list-style-type: none"> • The intersection is located 0.3 miles west of the St. Johns River Bridge.
Surrounding Development	<ul style="list-style-type: none"> • Development along SR 44 is rural and residential.
Land Uses at Intersection	<ul style="list-style-type: none"> • Northeast-Woods • Northwest-Woods • Southwest-Woods • Southeast-Woods
Pedestrian Generators	<ul style="list-style-type: none"> • None
Traffic Control	<ul style="list-style-type: none"> • CR 42 is under stop sign and overhead red flashing beacon control. An overhead yellow flashing beacon is provided for SR 44.
Adjacent Signalized Intersections	<ul style="list-style-type: none"> • North Approach: None within influence of intersection • South Approach: N/A • East Approach: SR 15A (4.2 miles) • West Approach: None within influence of intersection
SR 44	<ul style="list-style-type: none"> • <u>Function</u>-Arterial roadway in Lake and Volusia Counties. • <u>Connectivity</u>-SR 15A to the east and US 441 to the west • <u>Cross Section</u>-Two lane undivided roadway with a rural typical section and an open drainage system • <u>Posted Speed Limit</u>-East Approach: 45 mph, West Approach: 45 mph • <u>East Approach Lanes</u>-One through lane and a right turn lane • <u>West Approach Lanes</u>-One left turn lane and one through lane • <u>Alignment</u>-No horizontal or vertical curves in the vicinity of the intersection. • <u>Sidewalks</u>-None • <u>Utilities</u>-Overhead power lines on the south side of the roadway • <u>Street Lighting</u>-None
CR 42	<ul style="list-style-type: none"> • <u>Function</u>-County collector roadway • <u>Connectivity</u>-SR 19 to the north and SR 44 to the south • <u>Cross Section</u>-Two lane roadway with a rural typical section and an open drainage system • <u>Posted Speed Limit</u>-North Approach: 55 mph, South Approach: N/A • <u>North Approach Lanes</u>-One multi-purpose lane • <u>South Approach Lanes</u>-N/A • <u>Alignment</u>-Approaches SR 44 on a slight skew • <u>Sidewalks</u>-None • <u>Utilities</u>-Overhead utilities on the west side of the roadway • <u>Street Lighting</u>-None
Other Distinct Features	<ul style="list-style-type: none"> • Drawbridge over St. John's River approximately 1.3 miles to the east.

Exhibit 1-North Approach Photographs



Looking south into the intersection along CR 42



Looking north from the intersection along CR 42

Exhibit 2-East Approach Photographs



Looking west into the intersection along SR 44



Looking east from the intersection along SR 44

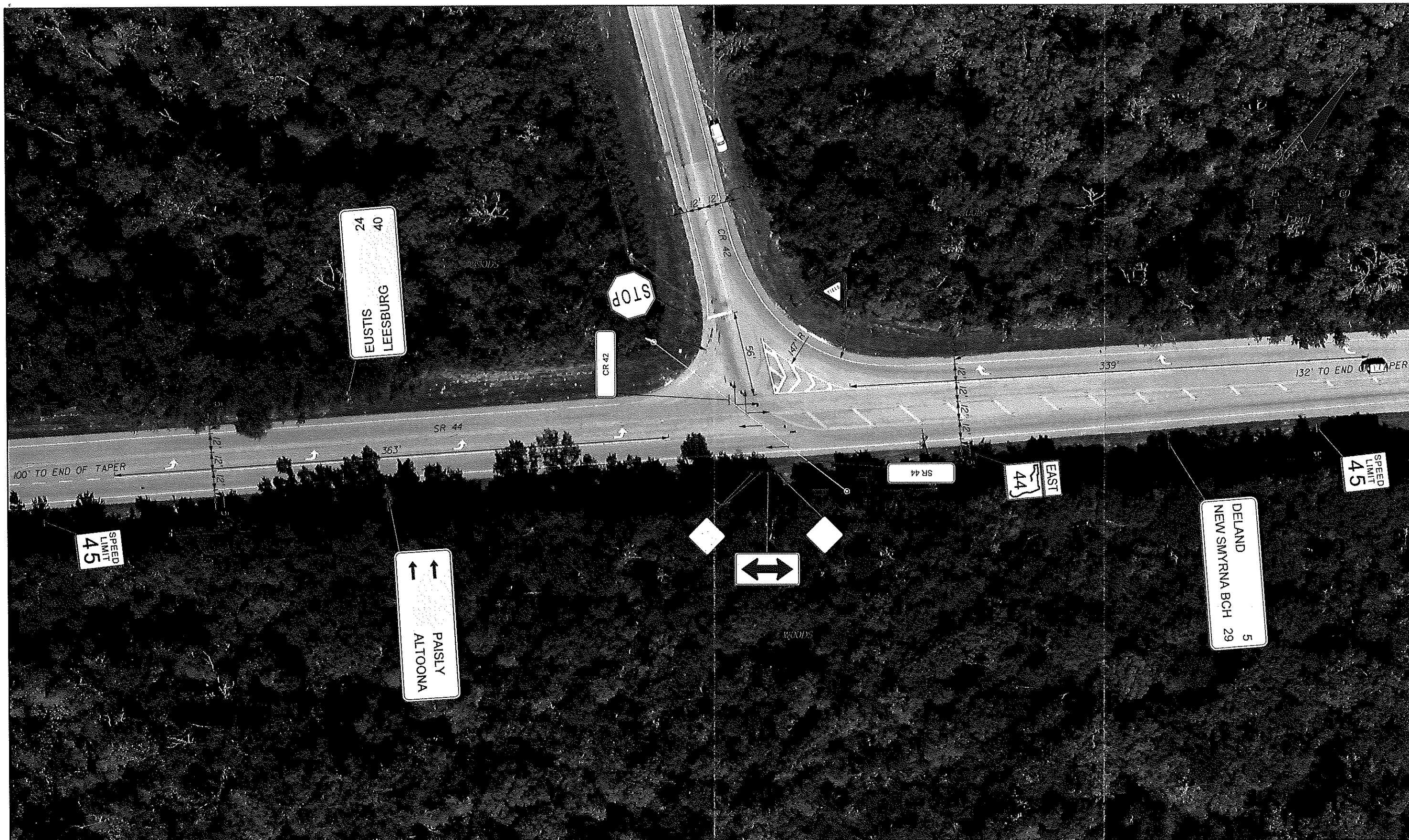
Exhibit 3-West Approach Photographs



Looking east into the intersection along SR 44



Looking west from the intersection along SR 44



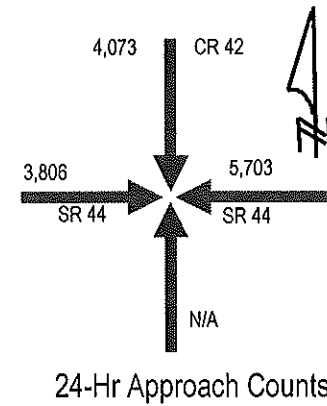
	CONTROLLER CABINET		DELINEATOR		DITCH BOTTOM INLET		GUARDRAIL
	TRAFFIC SIGNAL POLE		POWER POLE		MANHOLE		FENCE
	SIGNAL HEAD		LIGHT POLE		MITERED END SECTION		TREE/SHRUB
	SIGN		HYDRANT		DRAINAGE INLET		BUILDING

Faller, Davis & Associates, Inc.

FIGURE 2
CONDITION DIAGRAM
CONTINUING SERVICES FOR TRAFFIC ENGINEERING

Traffic Volumes

Twenty-four hour machine approach counts were collected on the approaches to the intersection. According to these counts, approximately 4,000 southbound, 3,800 eastbound, and 5,700 westbound vehicles approached the intersection on the day of the study.



The eight highest hours were identified utilizing the approach count data. The count periods selected include the hours 6:00 AM to 10:00 AM, 11:00 AM to 1:00 PM and 4:00 to 6:00 PM.

The eight-hour turning movement count reveals that the peak traffic volumes on SR 44 occur from 5:00 to 6:00 PM with a total of 931 vph approaching the intersection. The peak traffic volumes on CR 42 occur from 6:00 to 7:00 AM with 237 vph approaching the intersection. The following table summarizes the minimum and maximum and distribution of turning movements during the eight highest hours:

Table 2-Turning Movement Count Summary

MOVEMENT		NB		SB		EB		WB	
		Min	Max	Min	Max	Min	Max	Min	Max
Left	Volume	0	0	93	222	6	31	0	0
	App % Avg	0%		93%		4%		0%	
Through	Min - Max	0	0	0	0	181	328	155	351
	App % Avg	0%		0%		96%		66%	
Right	Min - Max	0	0	5	16	0	0	42	258
	App % Avg	0%		7%		0%		34%	
U-Turn	Min - Max	0	0	0	0	0	0	0	0
	App % Avg	0%		0%		0%		0%	

No pedestrians or bicyclists were observed crossing the approaches of the intersection during the count period. The turning movement data is presented in further detail in the Appendix.

Collision Data

Crash data was provided by the Florida Department of Transportation for the intersection of SR 44 at CR 42 for the 12-month period ending June 1, 2007. Nine collisions occurred at the intersection including two angle collisions, two rear end collisions, two hit tree/shrub collisions, one sideswipe collision, one hit utility pole collision, and one ran into ditch/culvert collision. The collisions resulted in one fatality, seven injuries, and an estimated \$58,100 in property damages.

A collision summary and diagram of the intersection have both been included on the following pages of this report.



⊗ FATAL ○ INJURY (XX) COLLISION NUMBER	←←← REAR END ←←← SIDESWIPE ←←← OUT OF CONTROL ←←← BACKED INTO	→→→ RIGHT TURN →→→ HIT PEDESTRIAN ↓ ANGLE	↙ LEFT TURN ← OVERTURNED →← HEAD ON ← HIT MOVEABLE OBJECT	○ HIT TREE → HIT SIGN → HIT UTILITY POLE → HIT DITCH	<i>Faller, Davis & Associates, Inc.</i>	FIGURE 3 COLLISION DIAGRAM CONTINUING SERVICES FOR TRAFFIC ENGINEERING	PAGE NO. 9
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TABLE 3

COLLISION DATA INTERSECTION SUMMARY																	
Section: 11110 Intersecting Street: CR 42 Source Data: Hard Copy Crash Reports Study Period: From 6/1/2006 to 5/31/2007 42 Months																	
Route: SR 44 County: Lake City: Unincorporated Lake County																	
No.	Long or Short Form	Date	Day	Time	DOB	Age	Alcohol/Drugs	Lighting Condition	Roadway Surface	Weather	Fatal	Injury	Most Severe Injury	Harmful Event	Property Damage	Sight Obstruction	Contributing Cause
1	Short	11/10/2006	Friday	18:14	3/31/1933	74	None	Dark (NO SL)	Dry	Clear	0	0	None	Sideswipe	\$0	None	FTYROW
2	Long	11/14/2006	Tuesday	6:50	8/15/1985	21	None	Daylight	Dry	Clear	1	2	Fatal	Angle	\$6,500	All Other	FTYROW
3	Long	11/24/2006	Friday	8:09	10/16/1975	31	None	Daylight	Dry	Clear	0	0	None	Rear End	\$6,000	None	Careless Driving
4	Long	12/1/2006	Thursday	5:15	12/23/1975	31	Alcohol	Dark (NO SL)	Dry	Clear	0	1	Incapacitating Non-	Hit Tree/Shrub	\$7,000	None	Alcohol/Drugs-Under Influence
5	Long	12/24/2006	Sunday	18:35	8/14/1972	34	None	Dark (NO SL)	Wet	Rain	0	3	Incapacitating Non-	Angle	\$20,000	None	FTYROW
6	Long	1/8/2007	Monday	1:24	Unk	Unk	None	Dark (NO SL)	Wet	Rain	0	0	None	Hit Utility Pole	\$4,000	None	Careless Driving
7	Long	1/23/2007	Tuesday	22:55	4/2/1979	28	None	Dark (NO SL)	Dry	Clear	0	1	Possible	Ran into Ditch/Culvert	\$1,000	None	Fleeing Police
8	Short	5/6/2007	Sunday	16:26	7/25/1978	29	None	Daylight	Wet	Cloudy	0	0	None	Rear End	\$13,200	None	Careless Driving Failed to Maintain Equipment/Vehicle
9	Long	5/9/2007	Wednesday	9:44	4/26/1967	40	None	Daylight	Dry	Clear	0	0	None	Hit Tree/Shrub	\$400	None	
Crash Statistics																	
Total Number of Crashes	Total Number of Long Form Crashes	Total Property Damage	Total Number of Fatalities	Total Number of Fatal Crashes	Total Number of Injuries	Total Number of Injury Crashes	None	Possible	Non-Incapacitating	Incapacitating	Fatal	Daylight	Dark (SL)	Dark (No SL)	Wet	Dry	Unknown
100%	78%	\$53,100	1	11%	7	4	5	11%	22%	0%	1	4	0	5	3	6	0
Rear End	Head On	Angle	Left Turn	Right Turn	Sideswipe	Backed Into	Parked Car	Collision with MV Other Road	Pedestrian	Bike	Bike (Bike Lane)	Moped	Train	Animal	Hit Sign/Sign Post	Hit Utility Pole	Hit Guardrail
2	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
22%	0%	22%	0%	0%	11%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	11%	0%
Hit Fence	Hit Concrete Barrier Wall	Hit Bridge/Pier/Abutment	Hit Tree/Shrub	Hit Const Banned/Sign/Brdg Pier/Abutt	Traffic Gate	Crash Attenuator	Fixed Object Above Road	Other Fixed Object	Moveable Object	Ran Into Ditch/Culvert	Ran Off Road Into Water	Overtuned	Occupant Fell From Vehicle	Trac/Trailer Jackknifed	Fire	Explosion	Unknown
0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0
0%	0%	0%	22%	0%	0%	0%	0%	0%	0%	11%	0%	0%	0%	0%	0%	0%	0%
No Improper Driving	Careless Driving	FTYROW	Improper Backing	Improper Lane Change	Improper Turn	Followed Too Closely	Disregarded Traffic Signal	Exceed Safe Speed Limit	Disregarded Stop Sign	Equipment/Vehi	Improper Passing	Drove Left of Center	Exceeded Stated Safe Speed Limit	Obstructing Traffic	Improper Load	Fleeing Police	Alcohol/Drugs-Under Influence
0	3	3	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1
0%	33%	33%	0%	0%	0%	0%	0%	0%	0%	11%	0%	0%	0%	0%	0%	11%	11%
AADT 13,582 Critical Crash Rate 1.41 Safety Ratio 4.45																	

Intersection Delay

Intersection delay studies were performed for the southbound movement and the eastbound left turn movement. The results of the delay studies are as follows:

Table 4-Summary of Delay Studies

Movement	Period	Time	Maximum Queue (Veh)	Average Delay per Vehicle (Sec)	Volume (Veh/Hr)	Total Delay (Veh-Sec)	Total Delay (Veh-Hr)	Maximum Stopped Time (Min)
Southbound Movement	AM	7:00-8:00	9	22	223	4,906	1.36	1.5
	Off (AM)	6:00-7:00	12	28	237	6,636	1.84	2.4
	PM	5:00-6:00	6	18	132	2,376	0.66	0.9
Eastbound Left Turn Movement	AM	7:00-8:00	1	7	3	21	0.01	0.1
	Off (AM)	6:00-7:00	1	6	4	24	0.01	0.1
	PM	5:00-6:00	2	31	20	620	0.17	0.4

3. QUALITATIVE ASSESSMENT

The intersection of SR 44 and CR 42 was observed by a registered professional engineer in the morning (6:00 to 8:00 AM) and afternoon (5:00 to 6:00 PM) peak periods to assess existing operating conditions and to determine the type of intersection traffic control that is in the best interest of the traveling public.

Request: The Lake County Public Works Department has requested a Signal Warrant Study be performed at the intersection of SR 44 and CR 42.

Operations: Operations include the efficiency of operation and interaction of motor vehicles, pedestrians, and bicycles at the intersection. Following are the observations relating to these factors:

- The traffic volumes on SR 44 are moderate averaging 600 vehicles per hour during the count period.
- The major side street turning movement was the southbound left turn at 237 vehicles per hour from 6:00 AM to 7:00 AM. It should be noted that 1,149 vehicles were observed making this movement over an eight hour period. The major mainline turning movement was the westbound right turn at 258 vehicles per hour from 5:00 PM to 6:00 PM.
- There are no signals located within four miles of the intersection in any direction. As such sporadic arrivals on SR 44 were observed which allowed sufficient gaps in traffic for vehicles to enter from CR 42.
- The speed limit east and west of the intersection on SR 44 is 55 mph. The speed limit is reduced to 45 mph within the operational limits of the CR 42 intersection. Vehicles were observed traveling at or above the posted speed limit of 45 mph.
- Southbound traffic on CR 42 was observed to be dispersed. Heavy vehicles were observed during the count periods, and a maximum queue of twelve vehicles was observed due to heavy vehicles entering SR 44 slowly.
- A maximum average delay of 28 seconds was recorded for the southbound movement. The large number of southbound left turning vehicles (237) during this period resulted in a delay of 1.84 vehicle/hours.
- There were no observed conflicts during the peak review periods.
- The current location of the stop line on CR 42 is 56 feet from the travel lane. Per MUTCD criteria the stop line should be no further than 30 feet from the edge of travel. The sight distance from the stop line is limited due to the heavily wooded areas on the adjacent quadrants. Southbound drivers were observed to not stop at the stop line. Instead, they would stop within ten feet of the edge of travel on SR 44. From this point the sight distance east and west is unobstructed. ***Consideration should be given to trimming the vegetation within the right of way on the northwest corner.***

- Westbound right turning drivers were observed to complete their turn with little or no delay. The westbound right turn is signed as a yield condition, but with no northbound opposing movement and very few eastbound left turns, westbound right turning drivers were typically observed to complete their turns with minimal delay.

Safety: Vehicle, pedestrian, and bicycle safety at the intersection are assessed through review of crash reports, identification of significant crash trends, then correlation to field conditions. Following are the observations relating to the safety of the intersection.

- Crash data was provided by the Florida Department of Transportation for the intersection of SR 44 at CR 42 for the 12-month period ending June 1, 2007. Nine collisions occurred at the intersection resulting in one fatality, seven injuries, and an estimated \$58,100 in property damage.
- Two angle collisions occurred between southbound left turning vehicles and westbound through vehicles. The contributing cause to both collisions was failure to yield the right of way by the sidestreet driver. The collisions resulted in one fatality and five injuries. The fatality occurred when a southbound driver entered the path of a westbound through vehicle. The southbound vehicle was spun around after impact and ended up in the eastbound lane. An eastbound through vehicle impacted the southbound vehicle on the passenger side, killing the passenger.
- Two hit tree/shrub collisions occurred at the intersection. One collision was due to a mechanical failure on the vehicle, and the other was due to driving under the influence of alcohol. The collisions resulted in one injury.
- Two southbound rear end collisions occurred on CR 42 at the intersection. The trailing vehicle was at fault in both cases as the driver could not stop in time to avoid a collision. The contributing cause for both crashes was careless driving.
- There was one sideswipe collision between an eastbound left turning vehicle and a westbound right turning vehicle. The collision happened at the north end of the right turn painted island. The westbound vehicle failed to yield the right of way to the eastbound vehicle. ***Consideration should be given to installing a yield line for the westbound right turn movement.***
- There was one "ran into ditch/culvert" collision. The crash was the result of a driver fleeing police and losing control at the intersection. The fleeing vehicle ran into a ditch. The collision resulted in one injury.
- There was one hit utility pole collision. The driver of the vehicle lost control of the vehicle for unknown reasons and impacted the signal pole in the northwest corner.

Maintenance: In addition to observing operational and safety conditions, correctible maintenance items are also identified during the field review. Following is a summary of maintenance items observed at the intersection.

- The existing signs and pavement markings are in good condition and properly applied with one exception. Per the MUTCD criteria, when two numbered roads intersect a junction route assembly and directional assembly should be provided on each approach. On CR 42 a junction SR 44 sign assembly is provided. ***A directional "EAST" and "WEST" SR 44 sign assembly should be placed on CR 42 approaching SR 44 to comply with the MUTCD criteria.***

4. SIGNAL WARRANT ANALYSIS

The traffic volumes and geometric conditions at the intersection were compared with the warrants for the installation of traffic signals contained in the Manual on Uniform Traffic Control Devices (MUTCD-2003) and Manual on Uniform Traffic Studies (MUTS).

For the purposes of the Signal Warrant Analysis, SR 44 is considered the major street and CR 42 the minor street. Based on the posted speed limit of 45 mph on SR 44, the 70 percent volume criterion was applied to the analysis. The following table summarizes the results of the warrant analysis during the study hours:

Table 5-Summary of Signal Warrant Analysis

Warrant	Applicable	Satisfied	Comments	
1A	Minimum Vehicular Volume	Yes	Yes	The side street traffic volumes meet the requirements of this warrant.
1B	Interruption of Continuous Traffic	Yes	80% / 56%	The mainline volumes do not meet the requirements of this warrant but the side street traffic volumes meet the 70% and 80%/56% requirements of this warrant.
2	Four Hour Vehicular Volume	Yes	Yes	The side street traffic volumes meet the requirements of this warrant.
3	Peak Hour	No	Yes	This warrant is not applicable as no unusual traffic condition that discharges a large volume of traffic in a short period of time exists at this intersection.
4	Pedestrian Volume	Yes	No	This warrant is applicable but is not satisfied.
5	School Crossing	No	No	This warrant is not applicable as no school crossing exists at the intersection.
6	Coordinated Signal System	No	No	This warrant is not applicable as there is no existing signal system in this area.
7	Crash Experience	Yes	No	This warrant is not satisfied as less than five correctible crashes were reported at this intersection in the last 12 months.
8	Roadway Network	Yes	No	This warrant is applicable but is not satisfied.

Based on warrants 1A and 2 being satisfied, a fully actuated traffic signal should be installed at this intersection. The signal should include a mainline phase and a sidestreet phase.

- **A left turn phase warrant was prepared for the eastbound left turn movement and the installation of a protected eastbound left turn phase is not warranted. The left turn phase warrant is included in the appendix.**
- **Although there is an average of 234 westbound right turns during the afternoon period of 4:00 to 6:00 PM, a protected westbound right turn overlap phase is not recommended to be installed.**
- **Pedestrian features are not recommended as there were no pedestrians/bicyclists observed during the count period.**
- **The original signal plan was obtained from the Department, and a cursory review of the design was performed. It was found that the flashing beacon signal was designed to accommodate a future signal. The span wires were mounted high enough to mount a five section head and still obtain a roadway clearance of 17.50 feet. A preliminary ATLAS analysis was performed based on information taken from the provided signal plan and the conceptual signal layout. It was found that the current signal structure should support the proposed configuration. The signal should be further analyzed using field data prior to utilizing the structure for a fully actuated signal.**

TRAFFIC SIGNAL WARRANT SUMMARY

City: Unincorporated
County: Lake

Engineer: KRC
Date: October 9, 2007

Major Street: SR 44
Minor Street: CR 42

Lanes: 1 Critical Approach Speed: 45
Lanes: 1

Volume Level Criteria

1. Is the critical speed of major street traffic > 70 km/h (40 mph)? Yes No
 2. Is the intersection in a built-up area of isolated community of <10,000 population? Yes No
 If Question 1 or 2 above is answered "Yes", then use "70%" volume level 70% 100%

WARRANT 1 - EIGHT-HOUR VEHICULAR VOLUME

Warrant 1 is satisfied if Condition A or Condition B is "100%" satisfied.
Warrant is also satisfied if both Condition A and Condition B are "80%" satisfied.

Applicable: Yes No
Satisfied: Yes No

Condition A - Minimum Vehicular Volume

Satisfied: Yes No
80% / 56% Satisfied: Yes No

(volumes in veh/hr)	Minimum Requirements (80% Shown in Parenthesis) {56% Shown in Brackets}				Eight Highest Hours							
	1		2 or more		600	700	800	900	1100	1200	1600	1700
	100%	70%	100%	70%								
Approach Lanes	1		2 or more									
Volume Level	100%	70%	100%	70%								
Both Approaches on Major Street	500 (400)	350 {280}*	600 (480)	420 {336}*	493	620	510	499	504	501	826	931
Highest Approach on Minor Street	150 (120)	105 {84}*	200 (160)	140 {112}*	237	223	195	125	116	109	129	132

Record 8 highest hours and the corresponding volumes in boxes provided. Condition is 100% satisfied if the minimum volumes are met for eight hours. Condition is (80%) / (56%)* satisfied if parenthetical volumes are met for eight hours.

Condition B - Interruption of Continuous Traffic

Condition B is intended for application where the traffic volume is so heavy that traffic on the minor street suffers excessive delay or conflict.

Applicable: Yes No
Excessive Delay/Conflict: Yes No
Satisfied: Yes No
80% / 56% Satisfied: Yes No

(volumes in veh/hr)	Minimum Requirements (80% Shown in Parenthesis) {56% Shown in Brackets}				Eight Highest Hours							
	1		2 or more		600	700	800	900	1100	1200	1600	1700
	100%	70%	100%	70%								
Approach Lanes	1		2 or more									
Volume Level	100%	70%	100%	70%								
Both Approaches on Major Street	750 (600)	525 {420}*	900 (720)	630 {504}*	493	620	510	499	504	501	826	931
Highest Approach on Minor Street	75 (60)	53 {42}*	100 (80)	70 {56}*	237	223	195	125	116	109	129	132

Record 8 highest hours and the corresponding volumes in boxes provided. Condition is 100% satisfied if the minimum volumes are met for eight hours. Condition is (80%) / (56%)* satisfied if parenthetical volumes are met for eight hours.

 Volume taken from 24 hour count

TRAFFIC SIGNAL WARRANT SUMMARY

City: Unincorporated Engineer: KRC
 County: Lake Date: October 9, 2007
 Major Street: SR 44 Lanes: 1 Critical Approach Speed: 45
 Minor Street: CR 42 Lanes: 1

Volume Level Criteria

1. Is the critical speed of major street traffic > 70 km/h (40 mph)? Yes No
 2. Is the intersection in a built-up area of isolated community of <10,000 population? Yes No
 If Question 1 or 2 above is answered "Yes", then use "70%" volume level 70% 100%

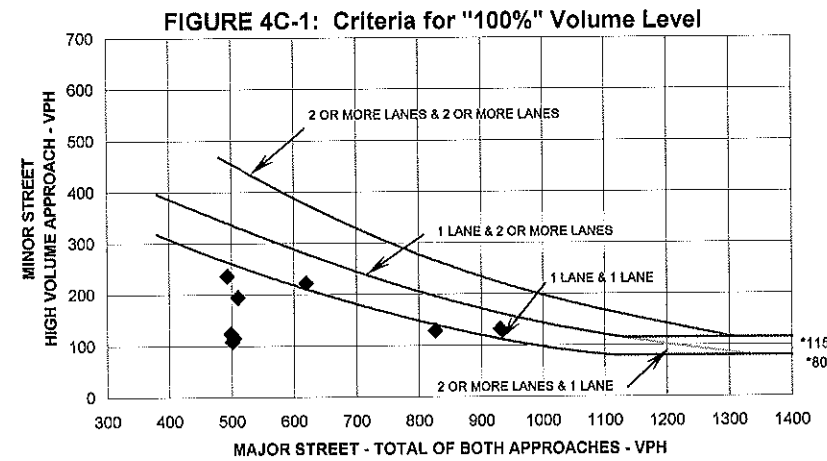
WARRANT 2 - FOUR-HOUR VEHICULAR VOLUME

If any four points lie above the appropriate line, then the warrant is satisfied.

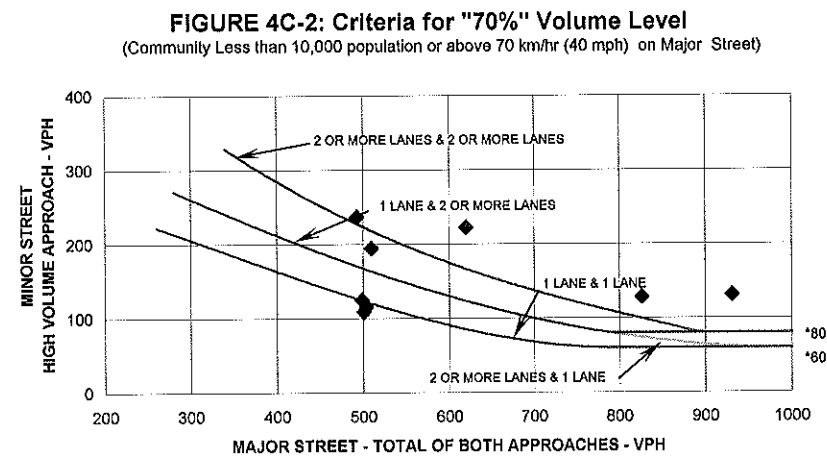
Applicable: Yes No
 Satisfied: Yes No

Plot four volume combinations on the applicable figure below.

Hour	Warranting Volumes		Met	
	Major Street	Minor Street	100%	70%
600	493	237	<input type="checkbox"/>	<input checked="" type="checkbox"/>
700	620	223	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
800	510	195	<input type="checkbox"/>	<input checked="" type="checkbox"/>
900	499	125	<input type="checkbox"/>	<input type="checkbox"/>
1100	504	116	<input type="checkbox"/>	<input type="checkbox"/>
1200	501	109	<input type="checkbox"/>	<input type="checkbox"/>
1600	826	129	<input type="checkbox"/>	<input checked="" type="checkbox"/>
1700	931	132	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>



* Note: 115 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 80 vph applies as the lower threshold volume threshold for a minor street approach with one lane.



* Note: 80 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 60 vph applies as the lower threshold volume threshold for a minor street approach with one lane.

TRAFFIC SIGNAL WARRANT SUMMARY

City: Unincorporated
County: Lake

Engineer: KRC
Date: October 9, 2007

Major Street: SR 44
Minor Street: CR 42

Lanes: 1 Critical Approach Speed: 45
Lanes: 1

Volume Level Criteria

- Is the critical speed of major street traffic > 70 km/h (40 mph)? Yes No
 - Is the intersection in a built-up area of isolated community of <10,000 population? Yes No
- If Question 1 or 2 above is answered "Yes", then use "70%" volume level 70% 100%

WARRANT 3 - PEAK HOUR

If all three criteria are fulfilled or any of the plotted points lie above the appropriate line, then the warrant is satisfied.

Applicable: Yes No
Satisfied: Yes No

Unusual condition justifying use of warrant:

None

Record hour when criteria are fulfilled and the corresponding delay or volume in boxes provided.

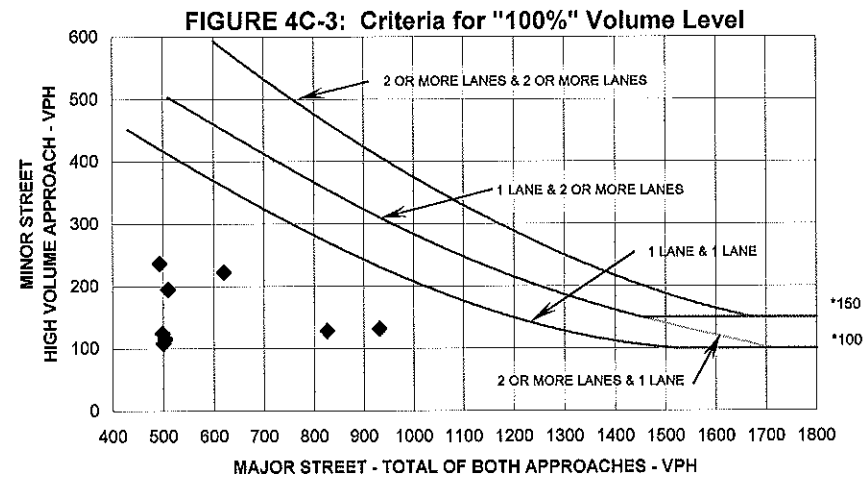
Warranting Volumes			100%	70%
600	493	237		<input checked="" type="checkbox"/>
700	620	223		<input checked="" type="checkbox"/>
800	510	195		
900	499	125		
1100	504	116		
1200	501	109		
1600	826	129		<input checked="" type="checkbox"/>
1700	931	132		<input checked="" type="checkbox"/>

1. Delay on Minor Approach *(vehicle-hours)		
Approach Lanes	1	2
Delay Criteria*	4.0	5.0
Delay*	1.8	0.0
Fulfilled?:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No

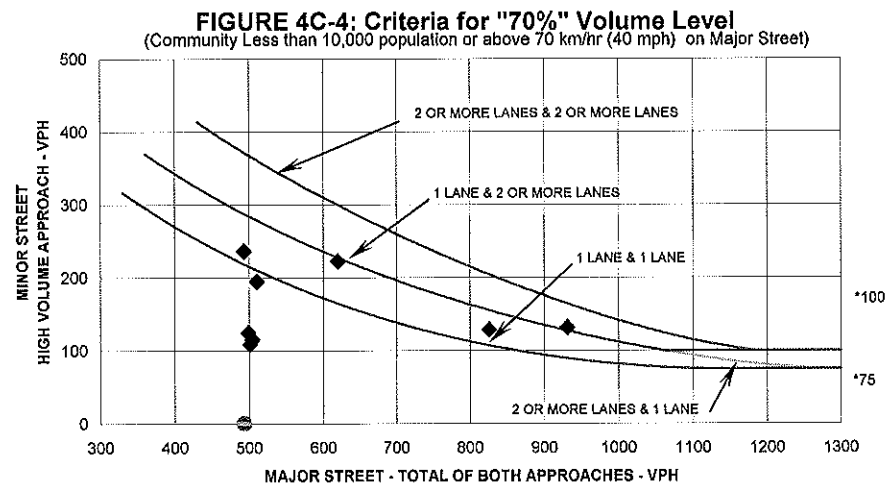
2. Volume on Minor Approach *(vehicles per hour)		
Approach Lanes	1	2
Volume Criteria*	100	150
Volume*	237	0
Fulfilled?:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No

3. Total Entering Volume *(vehicles per hour)		
No. of Approaches	3	4
Volume Criteria*	650	800
Volume*	836	0
Fulfilled?:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No

Plot volume combination on the applicable figure below.



* Note: 150 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 100 vph applies as the lower threshold volume threshold for a minor street approach with one lane.



* Note: 100 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 75 vph applies as the lower threshold volume threshold for a minor street approach with one lane.

TRAFFIC SIGNAL WARRANT SUMMARY

City: Unincorporated
County: Lake

Engineer: KRC
Date: October 9, 2007

Major Street: SR 44
Minor Street: CR 42

Lanes: 1 Critical Approach Speed: 45
Lanes: 1

WARRANT 4 - PEDESTRIAN VOLUME

Record hours where criteria are fulfilled and the corresponding volume or gap frequency in the boxes provided. The warrant is satisfied if condition 1 or 2 is fulfilled and condition 3 is fulfilled.

Applicable: Yes No
Satisfied: Yes No

Criteria	Hour	Pedestrian Volume	Pedestrian Gaps	Fulfilled?	
				Yes	No
1. Pedestrian volume crossing the major street is 100 ped/hr or more for each of any four hours and there are less than 60 gaps per hour in the major street traffic stream of adequate length.	0	0	0		
	0	0	0		<input checked="" type="checkbox"/>
	0	0	0		
	0	0	0		
2. Pedestrian volume crossing the major street is 190 ped/hr or more for any one hour and there are less than 60 gaps per hour in the major street traffic stream of adequate length.	600	0	0		<input checked="" type="checkbox"/>
3. The nearest traffic signal along the major street is located more than 90 m (300 ft) away, or the nearest signal is within 90 m (300 ft) but the proposed traffic signal will not restrict the progressive movement of traffic.				<input checked="" type="checkbox"/>	

WARRANT 5 - SCHOOL CROSSING

Record hours where criteria are fulfilled and the corresponding volume or gap frequency in the boxes provided. The warrant is satisfied if all three of the criteria are fulfilled.

Applicable: Yes No
Satisfied: Yes No

Criteria			Fulfilled?	
	Yes	No	Yes	No
1. There are a minimum of 20 students crossing the major street during the highest crossing hour.	Students: 0	Hour: 0		<input checked="" type="checkbox"/>
2. There are fewer adequate gaps in the major street traffic stream during the period when the children are using the crossing than the number of minutes in the same period.	Minutes: 0	Gaps: 0		<input checked="" type="checkbox"/>
3. The nearest traffic signal along the major street is located more than 90 m (300 ft) away, or the nearest signal is within 90 m (300 ft) but the proposed traffic signal will not restrict the progressive movement of traffic.			<input checked="" type="checkbox"/>	

WARRANT 6 - COORDINATED SIGNAL SYSTEM

Indicate if the criteria are fulfilled in the boxes provided. The warrant is satisfied if either criterion is fulfilled. This warrant should not be applied when the resulting signal spacing would be less than 300 m (1,000 ft).

Applicable: Yes No
Satisfied: Yes No

Criteria	Fulfilled?	
	Yes	No
1. On a one-way street or a street that has traffic predominately in one direction, the adjacent signals are so far apart that they do not provide the necessary degree of vehicle platooning.		<input checked="" type="checkbox"/>
2. On a two-way street, adjacent signals do not provide the necessary degree of platooning, and the proposed and adjacent signals will collectively provide a progressive operation.		<input checked="" type="checkbox"/>

Source: Revised from NCHRP Report 457

Exhibit 8

TRAFFIC SIGNAL WARRANT SUMMARY

City: Unincorporated
County: Lake

Engineer: KRC
Date: October 9, 2007

Major Street: SR 44
Minor Street: CR 42

Lanes: 1 Critical Approach Speed: 45
Lanes: 1

WARRANT 7 - CRASH EXPERIENCE

Record hours where criteria are fulfilled, the corresponding volume, and other information in the boxes provided. The warrant is satisfied if all three of the criteria are fulfilled.

Applicable: Yes No
Satisfied: Yes No

Criteria	Hour	Volume	Met?		Fulfilled?	
			Yes	No	Yes	No
1. One of the warrants to the right is met.	Warrant 1, Condition A (80% satisfied)		<input checked="" type="checkbox"/>			
	Warrant 1, Condition B (80% satisfied)		<input checked="" type="checkbox"/>			
	Warrant 4, Pedestrian Volume at 80% of volume requirements:	0	0		<input checked="" type="checkbox"/>	
	80 ped/hr for four (4) hours or	0	0		<input checked="" type="checkbox"/>	
	152 ped/hr for one (1) hour	0	0		<input checked="" type="checkbox"/>	
2. Adequate trial of other remedial measure has failed to reduce crash frequency.	Measure tried:	Overhead Flasher			<input checked="" type="checkbox"/>	
3. Five or more reported crashes, of types susceptible to correction by signal, have occurred within a 12-mo. period.	Number of crashes per 12 months:	2				<input checked="" type="checkbox"/>

WARRANT 8 - ROADWAY NETWORK

Record hours where criteria are fulfilled, and the corresponding volume or other information in the boxes provided. The warrant is satisfied if at least one of the criteria is fulfilled and if all intersecting routes have one or more of the characteristics listed.

Applicable: Yes No
Satisfied: Yes No

Criteria	Met?		Fulfilled?		
	Yes	No	Yes	No	
1. Both of the criteria to the right are met.	a. Total entering volume of at least 1,000 veh/hr during a typical weekday peak hour.	Entering Volume: 1,063	<input checked="" type="checkbox"/>		
	b. Five-year projected volumes that satisfy one or more of Warrants 1, 2, or 3.	Warrant: 1 2 3		<input checked="" type="checkbox"/>	
		Satisfied?: NO NO NO			
2. Total entering volume at least 1,000 veh/hr for each of any 5 hrs of a non-normal business day (Sat. or Sun.)	N/A	N/A	N/A	N/A	<input checked="" type="checkbox"/>
	N/A	N/A	N/A	N/A	

Characteristics of Major Routes	Met?		Fulfilled?	
	Yes	No	Yes	No
1. Part of the street or highway system that serves as the principal roadway network for through traffic flow.	Major Street:	<input checked="" type="checkbox"/>		
	Minor Street:		<input checked="" type="checkbox"/>	
2. Rural or suburban highway outside of, entering, or traversing a city.	Major Street:	<input checked="" type="checkbox"/>		
	Minor Street:		<input checked="" type="checkbox"/>	
3. Appears as a major route on an official plan.	Major Street:	<input checked="" type="checkbox"/>		
	Minor Street:		<input checked="" type="checkbox"/>	

CONCLUSIONS

Warrants Satisfied: 1 2

Remarks: _____

5. RECOMMENDATIONS

Based on the results of the signal warrant analysis, field observations, and engineering judgment, the following recommendations were developed:

1. Based on the fact that warrants 1A and 2 are satisfied, a fully actuated traffic signal should be installed at this intersection. The signal should include a mainline phase and a sidestreet phase.
 - A left turn phase warrant was prepared for the eastbound left turn movement and the installation of a protected eastbound left turn phase is not warranted.
 - Although there is an average of 234 westbound right turns during the afternoon period of 4:00 to 6:00 PM, a protected westbound right turn overlap phase is not recommended to be installed.
 - Pedestrian features are not recommended as there were no pedestrians/bicyclists observed during the count period.
 - The original signal plan for the flashing beacon was obtained from the Department, and a cursory review of the design was performed. It was found that the signal was designed to accommodate a future signal. The span wires were mounted high enough to mount a five section head and still obtain a roadway clearance of 17.50 feet. A preliminary ATLAS analysis was performed based on information taken from the provided signal plan and the conceptual signal layout. It was found that the current signal structure should support the proposed configuration. The signal should be further analyzed using field data prior to utilizing the structure for a fully actuated signal.
2. Consideration should be given to installing directional "East" and "West" SR 44 sign assemblies on CR 42 north of SR 44 to comply with MUTCD criteria.
3. Consideration should be given to trimming the vegetation within the right of way on the northwest corner.
4. Consideration should be given to installing a yield line for the westbound right turn movement.

A conceptual improvement diagram has been developed to further depict the recommended improvements and is included on the following page.



CONSIDER INSTALLING SR 44 DIRECT

CONSIDER TRIMMING VEGETATION ON NORTHWEST CORNER

- | | | | |
|---|---------------------|---|---|
| ☒ | CONTROLLER CABINET | ▲ | DELINE/ |
| ⊙ | TRAFFIC SIGNAL POLE | ◇ | POWER |
| → | SIGNAL HEAD | ○ | LIGHT PG SERVICES FOR TRAFFIC ENGINEERING |
| • | SIGN | ○ | HYDRAN |

FIGURE 4

PAGE NO.

22

APPENDIX

24 HOUR MACHINE APPROACH COUNTS

LOCATION: SR 44 AT CR 42
 CITY: UNINCORPORATED
 COUNTY: LAKE
 DATE: SEPTEMBER 4, 2007
 N/S STREET: CR 42
 E/W STREET: SR 44

TIME BEGIN	NB	SB	N/S TOTAL	EB	WB	E/W TOTAL	GRAND TOTAL
12:00 AM	0	16	16	12	48	60	76
1:00	0	8	8	5	27	32	40
2:00	0	5	5	13	20	33	38
3:00	0	10	10	7	27	34	44
4:00	0	44	44	37	31	68	112
5:00	0	217	217	100	105	205	422
6:00	0	564	564	326	256	582	1146
7:00	0	600	600	350	294	644	1244
8:00	0	496	496	292	258	550	1046
9:00	0	300	300	232	267	499	799
10:00	0	314	314	213	264	477	791
11:00	0	283	283	217	293	510	793
12:00 PM	0	274	274	228	344	572	846
1:00	0	135	135	212	319	531	666
2:00	0	113	113	224	378	602	715
3:00	0	137	137	241	442	683	820
4:00	0	129	129	277	512	789	918
5:00	0	110	110	293	615	908	1018
6:00	0	94	94	189	407	596	690
7:00	0	68	68	136	244	380	448
8:00	0	67	67	80	223	303	370
9:00	0	45	45	61	168	229	274
10:00	0	36	36	37	103	140	176
11:00	0	8	8	24	58	82	90
TOTAL	0	4073	4073	3806	5703	9509	13582

TURNING MOVEMENT COUNT
 NORTH STREET: CR 42
 SOUTH STREET: N/A
 SR 44 AT CR 42

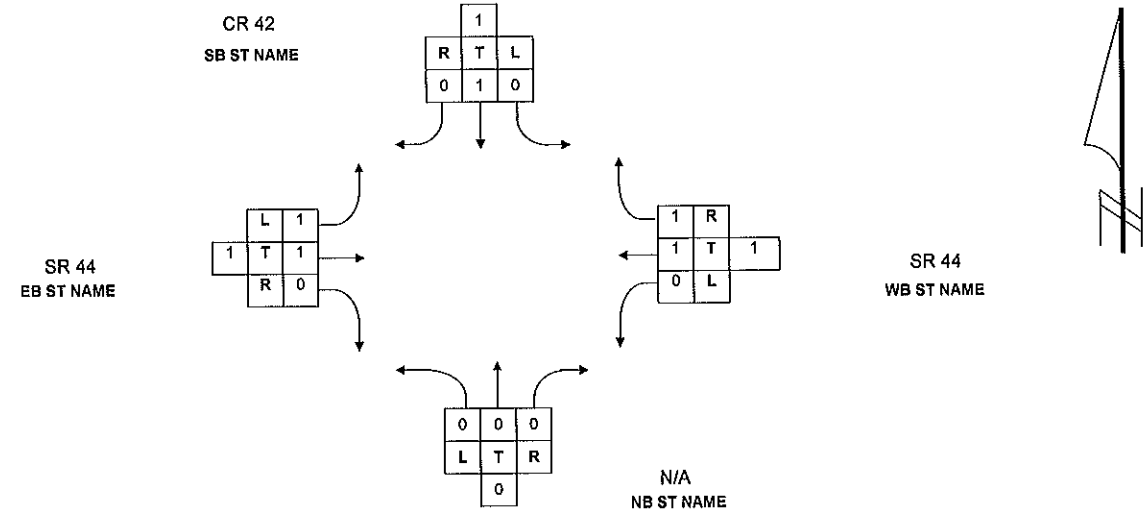
DATE: 9/12/2007
 EAST STREET: SR 44
 WEST STREET: SR 44
 TIME: 6AM-10AM, 11AM-1PM, 4-6PM
 BY: DM

START TIME	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			GRAND TOTAL
	LEFT	THRU	TOTAL	LEFT	THRU	TOTAL	LEFT	THRU	TOTAL	LEFT	THRU	TOTAL	
6:00	0	0	0	46	0	46	0	0	0	57	0	57	50
6:15	0	0	0	63	0	63	1	69	0	70	0	70	50
6:30	0	0	0	54	0	54	2	75	0	77	0	77	60
6:45	0	0	0	59	0	59	3	69	0	72	0	72	57
Total	0	0	0	222	0	222	6	270	0	276	0	276	217
7:00	0	0	0	52	0	52	4	80	0	84	0	84	66
7:15	0	0	0	43	0	43	3	73	0	76	0	76	80
7:30	0	0	0	62	0	62	0	101	0	101	0	101	63
7:45	0	0	0	50	0	50	4	74	0	74	0	74	76
Total	0	0	0	207	0	207	11	328	0	335	0	335	285
8:00	0	0	0	47	0	47	7	87	0	94	0	94	56
8:15	0	0	0	41	0	41	3	53	0	56	0	56	44
8:30	0	0	0	59	0	59	2	84	0	86	0	86	60
8:45	0	0	0	38	0	38	1	49	0	50	0	50	64
Total	0	0	0	185	0	185	13	273	0	286	0	286	224
9:00	0	0	0	35	0	35	3	44	0	47	0	47	37
9:15	0	0	0	27	0	27	3	52	0	55	0	55	58
9:30	0	0	0	30	0	30	1	47	0	48	0	48	55
9:45	0	0	0	28	0	28	1	38	0	39	0	39	58
Total	0	0	0	120	0	120	8	181	0	189	0	189	221
11:00	0	0	0	42	0	42	1	59	0	60	0	60	77
11:15	0	0	0	19	0	19	4	46	0	50	0	50	68
11:30	0	0	0	20	0	20	2	49	0	51	0	51	74
11:45	0	0	0	26	0	26	1	51	0	52	0	52	72
Total	0	0	0	107	0	107	8	205	0	213	0	213	291
12:00	0	0	0	33	0	33	3	44	0	47	0	47	72
12:15	0	0	0	16	0	16	3	48	0	51	0	51	67
12:30	0	0	0	19	0	19	0	58	0	58	0	58	61
12:45	0	0	0	30	0	30	1	61	0	62	0	62	83
Total	0	0	0	98	0	98	7	211	0	218	0	218	283
16:00	0	0	0	24	0	24	1	68	0	69	0	69	139
16:15	0	0	0	17	0	17	3	67	0	70	0	70	147
16:30	0	0	0	28	0	28	5	60	0	65	0	65	120
16:45	0	0	0	24	0	24	2	83	0	89	0	89	127
Total	0	0	0	93	0	93	15	278	0	293	0	293	533
17:00	0	0	0	30	0	30	11	86	0	97	0	97	143
17:15	0	0	0	23	0	23	10	64	0	74	0	74	133
17:30	0	0	0	29	0	29	2	69	0	71	0	71	185
17:45	0	0	0	35	0	35	8	72	0	80	0	80	148
Total	0	0	0	117	0	117	31	291	0	322	0	322	609

FLORIDA DEPARTMENT OF TRANSPORTATION
SUMMARY OF VEHICLE MOVEMENTS

SECTION 11110 CITY Unincorporated COUNTY Lake
 STATE ROUTE SR 44 INTERSECTING ROUTE CR 42
 OBSERVER DM DATE 9/12/2007 MILEPOST 23.703
 WEATHER Fair ROAD CONDITION Good
 REMARKS _____

FORM COMPLETED BY KRC DATE 10/09/07



TIME BEGIN/END	NORTHBOUND					SOUTHBOUND					TOTAL	EASTBOUND					WESTBOUND					TOTAL
	L	T	R	U	TOT	L	T	R	U	TOT	N/S	L	T	R	U	TOT	L	T	R	U	TOT	E/W
4 - 5																						
5 - 6																						
6 - 7	0	0	0	0	0	222	0	15	0	237	237	6	270	0	0	276	0	175	42	0	217	493
7 - 8	0	0	0	0	0	207	0	16	0	223	223	7	328	0	0	335	0	220	65	0	285	620
8 - 9	0	0	0	0	0	185	0	10	0	195	195	13	273	0	0	286	0	156	68	0	224	610
9 - 10	0	0	0	0	0	120	0	5	0	125	125	8	181	0	0	189	0	155	66	0	221	410
10 - 11																						
11 - 12	0	0	0	0	0	107	0	9	0	116	116	6	205	0	0	213	0	177	114	0	291	504
12 - 1	0	0	0	0	0	98	0	11	0	109	109	7	211	0	0	218	0	188	95	0	283	501
1 - 2																						
2 - 3																						
3 - 4																						
4 - 5	0	0	0	0	0	93	0	10	0	103	103	15	278	0	0	293	0	323	210	0	533	828
5 - 6	0	0	0	0	0	117	0	15	0	132	132	31	291	0	0	322	0	351	258	0	609	931
6 - 7																						
7 - 8																						
8 - 9																						
9 - 10																						
10 - 11																						
11 - 12																						
TOTAL	0	0	0	0	0	1,149	0	91	0	1,240	1,240	95	2,037	0	0	2,132	0	1,745	918	0	2,663	4,795

Percentage	0%	0%	0%	0%	93%	0%	7%	0%	4%	98%	0%	0%	0%	66%	34%	0%
Maximum	0	0	0	0	222	0	16	0	31	328	0	0	0	351	258	0
Minimum	0	0	0	0	93	0	5	0	6	181	0	0	0	155	42	0

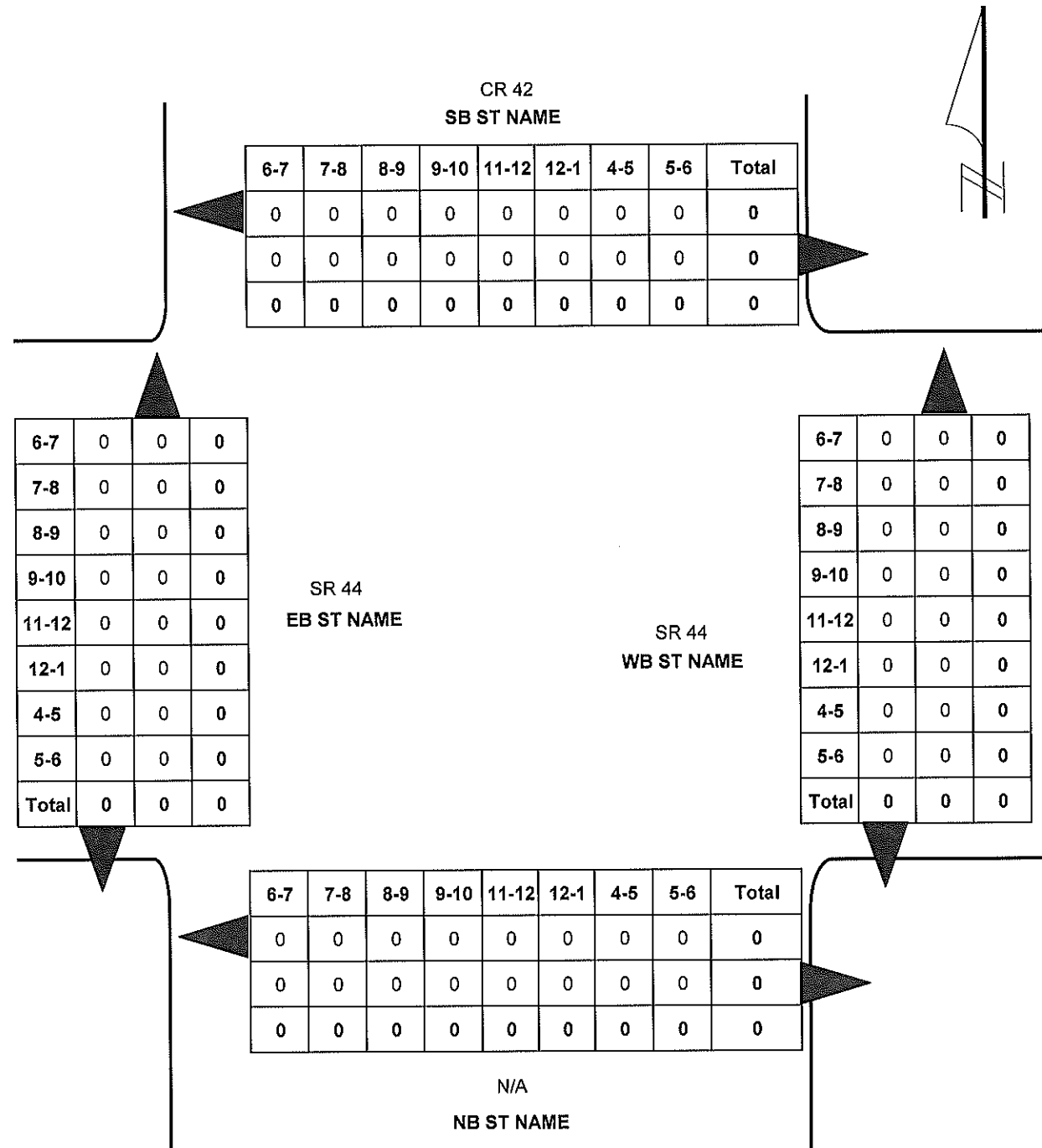
FLORIDA DEPARTMENT OF TRANSPORTATION

PEDESTRIAN MOVEMENT SUMMARY

SECTION 11110 CITY Unincorporated COUNTY Lake
 STATE ROUTE SR 44 INTERSECTING ROUTE CR 42
 OBSERVER DM DATE 9/6/2007 MILEPOST 23.703

REMARKS

FORM COMPLETED BY BM DATE 9/7/2007



LEFT TURN PHASE WARRANT SUMMARY

City: Unincorporated Engineer: KRC
 County: Lake Date: September 20, 2007
 Major Street: SR 44 Critical Approach Speed: 45
 Minor Street: CR 42

NORTHBOUND LEFT TURN PHASE

If any one of the six criteria below is satisfied then, a protected (protected-permitted or protected-only) left turn phase may be installed.

Applicable: Yes No
 Satisfied: Yes No

Criteria	Data								Fulfilled?	
	Year				Left Turn Crashes				Yes	No
1 Has there been more than four (4) left turn crashes in one year, or six (6) left turn crashes in two years? If yes, protected phasing recommended.	Jun 06 to Jun 07				0					<input checked="" type="checkbox"/>
2 Does left turn-driver have 5.5 seconds equivalent sight distance to oncoming vehicles? If not, protected phasing recommended.	Equivalent Sight Dist Time (Sec)									<input checked="" type="checkbox"/>
	6.0									
3 Number of left turn lanes on subject approach. If more than one, then protected phasing recommended.	Number of Left Turn Lanes									<input checked="" type="checkbox"/>
	1									
4 Number of through lanes on opposing approach. If four or more, then protected phasing recommended.	Number of Opposing Through Lanes									<input checked="" type="checkbox"/>
	1									
5 Is left turn delay >= 2.0 veh-hrs, and 35 sec/veh during the peak hour. If yes, then protected phasing recommended.	Left Turn Delay (veh-hrs)				Avg Veh Delay (sec/veh)					<input checked="" type="checkbox"/>
	0.40				100					
6 Is left-turn volume > 2 vehicles per cycle during the peak hour AND cross product of one lane approach > 50,000 or 100,000 for two lane approach? If yes, protected phasing recommended.	Cycle Length		Peak Volume			Veh/Cycle				<input checked="" type="checkbox"/>
	160		31			1.4				
Time	6-7	7-8	8-9	9-10	11-12	12-13	16-17	17-18		<input checked="" type="checkbox"/>
Eastbound Left Turn Volume	6	7	13	8	8	7	15	31		
Westbound Opposing Volume	217	285	224	221	291	283	533	609		
Cross Product	1,302	1,995	2,912	1,768	2,328	1,981	7,995	18,879		

Notes:
 1. Left Turn crashes obtained from FDOT.
 2. Equivalent sight distance time assumed to be greater than 5.5 seconds.
 3. Left turn delay not measured.